Research applied to mineral exploration

Observations on the Shovelnose epithermal gold prospect, British Columbia, Canada

Outcrop of colloform-banded quartz vein, diagnostic of epithermal deposits (Mik; ~10 cm wide, 66 g/t Au)

Report for:

Westhaven Ventures, Inc.

May, 2017

Prepared by:

Jeffrey W. Hedenquist

Hedenquist Consulting, Inc.

160 George Avenue, Suite 2501
Ottawa, Ontario K1N 9M2 Canada
Tel: 1(613) 230-9191

Contents page

Summary and recommendations

The Shovelnose property features an epithermal vein system hosted by volcanic and volcanic-hydrothermal units with syn-hydrothermal dike intrusions. Reported alteration is dominated by clays that formed at low temperature, and most veins, veinlets and breccia cement consist of cryptocrystalline to silica gel material that also indicates a low temperature of formation. This is likely due to a shallow paleodepth, i.e., a shallow level of erosion, and/or a location on the margin of the paleohydrothermal system.

The shallow polymictic fragmental unit (logged as a crystal lithic tuff) largely encountered at Tower and Alpine is likely of phreatomagmatic origin, given the abundance of altered clasts, i.e., a surficial deposit that is proximal to its source vent; this is supported by its thinning in the direction of Mik. Although the common mineralization of ~0.1-0.5 g/t Au over ~40-70 m drill intervals may be related to fine quartz veinlets developed in this shallow horizon, another possibility is that this geochemical signature is due to low levels of mineralization in the altered clasts that are contained in this unit (this possibility could be tested by selectively sampling all veinlets in a few 1-m intervals, by saw cut, and then assaying both the selected veinlets as well as the rest of the intervals).

There are also polymictic fragmental units recognized at greater depth (both Alpine and Mik) as well as syn-hydrothermal dikes, both of which will have intruded along zones of structural weakness. It is essential to determine structural controls on permeability, as indicated by cross-cutting features (dikes, phreatomagmatic bodies, veins), in order to target deeper structural zones that may be associated with mineralized veins. In addition, indications of paleothermal conditions, particularly proximity vectors, can be determined from alteration mineralogy to help in target selection.

The epithermal characteristics, size, and local indications of mineralization at the Shovelnose property indicate that untested potential remains, particularly in that most of the 39 drill holes tested shallow intervals, less than 100 to 150 m depth. Only half a dozen holes were drilled to ~200 to 300 m depth over ~1 km strike length in the Mik-Tower-Alpine area, with azimuth within ±30° of east-west. At present the major structural direction(s) are not fully known; demagnetized linear features may be related to major structures. There is alteration and vein evidence for the prospect to be continuous at least ~1.5 km west of the Mik-Tower-Alpine area. Given the extent of till cover in the area, it is also possible that the focus of the system is lateral from the principal area that has been drilled. An assessment of alteration mineralogy will help to identify the direction(s) to the higher paleotemperature zone(s), deeper and/or lateral from the present area of drill testing.

Recommendations

- Compile fracture measurements from the surface (azimuth and dip) for each area of the prospect, and determine the relationship between different areas (distinct fault blocks?). Relate the vein orientations at the surface to mapped structures.
- Use the improvement in knowledge of the lithology gained from the holes drilled during 2011 to 2016 and refine the stratigraphic column prior to relogging the core. Establish a consistent descriptive terminology and record details in logs that include the lithology(ies) of lithic clasts in fragmental units (volcanic fragmental and brecciated intervals), etc.
- Correlate stratigraphic horizons, dike intersections, etc., between drill holes on sections, in order to identify fault offset and major structures. In particular, distinguish the polymictic fragmental units (mainly of phreatomagmatic origin), that crosscut lithology in places at depth, from the lithic tuffs of volcanic origin (typically

monomictic, or at least without an altered clast content). Correlation of syn-hydrothermal dikes as well as phreatomagmatic intrusions will help to identify major structures that may have been subsequently reopened at depth and mineralized with epithermal quartz veins.

- Request an experienced geophysicist who is briefed on the geology of the prospect to examine the ground magnetic surveys to determine the data quality, and if adequate, process to RTP (reduced to pole) as well as vertical gradient, as appropriate to identify linear features of demagnetization as well as intrusive bodies.
- If the magnetic information indicates linear features associated with alteration, consider increasing the resolution of the survey to 50-m line spacing. Use the magnetic susceptibility data from representative drill core, as appropriate, in the subsequent processing. Examine depth slices of magnetic signatures and assess the potential to identify corridors of demagnetization associated with fracture/fault zones.
- Conduct an orientation survey of alteration mineralogy (particularly clays) by SWIR (short wave infrared). Collect samples in different lithologies from representative drill holes in each area, perhaps ~100-150 samples. Based on the results, consider whether a more extensive sampling program (e.g., rental of SWIR equipment with in-house interpretation of spectra) is warranted on more holes and in more detail, as well as measurement during logging of new holes while drilling.
- Oriented core should be required during future exploration drilling to allow the orientation of sub-surface veins and other structures to be determined, to incorporate into a structural model of the deposit that can be tested with further drilling.
- Consider the larger area, and whether there is evidence for hydrothermal activity beyond the area of known gold-in-soil anomalies and indications of mineralization in outcrop and drill hole, e.g., toward the possible flow-dome of Tower Hill.

Introduction

Mr. Gareth Thomas, Director of Westhaven Ventures, Inc., of Vancouver, requested the author to examine the Shovelnose property in British Columbia and the work that has been completed to date on this epithermal gold prospect. The author spent one day in the field, and a second day reviewing drill core from several drill holes. In addition to Thomas, Westhaven geologists John Peters and Peter Fischl plus consultant Ed Balon joined in the visit. These people are all thanked for their observations, comments, and contribution to this report. The conclusions and recommendations are the responsibility of the author.

Background

The Spences Bridge Group in the Merritt region of British Columbia is a Cretaceous volcanic belt that hosts a number of epithermal prospects. These quartz vein prospects were the apparent sources of placer gold for gold rushes, the first in the1800s. Regional stream silt samples led to the initial indication of the prospects in the early 2000s, with follow-up prospecting identifying the in situ vein sources. A 68 ppb gold-in-stream-silt anomaly on the NW slopes of Shovelnose Mountain led to the eventual discovery in 2006 of an area of silicification and clay alteration of rhyolitic tuffs. Quartz veins identified by Strongbow returned up to 0.5 g/t Au in an area called the Tower showing of the Shovelnose prospect. Initial work on the prospect by Strongbow included soil sampling, bedrock mapping, hand trenching and an airborne geophysical survey. Continued work in 2007 identified two other areas, Mik ~400 m SW of Tower (with a colloform-banded quartz vein returning 43.8 g/t Au), and Line 6 ~1.5 km west of Tower (with up to 5.1 g/t Au over a 6 m channel, and a 46.5 g/t Au result from chip sampling of quartz veins). The Brookmere area west of Line 6 was subsequently identified, and in 2010 a ground magnetic survey was conducted.

Westhaven Ventures became the operator of the property in 2011, and in addition to continued surface sampling and trenching, the first shallow drill holes were completed (606 m in seven holes). In 2012 there was a further ground magnetic survey and an initial induced polarization (IP) survey, with drilling of a further five holes totaling 778 m. In 2013 further ground magnetic and IP lines were measured, and eight holes totaling 1043 m were drilled, and six holes of 662 m were drilled in 2014 (total 26 holes, average 119 m depth). Subsequently in 2015 a LIDAR-produced DEM of topography was produced (Fig. 1), and further ground geophysical surveys included ground magnetics (Fig. 2) and IP plus VLF-EM. The Alpine zone, a few 100s m east of Tower, was identified beneath thick till cover. Five holes were drilled in 2015 (total 1408 m), from Line 6 to Alpine, and in 2016, nine holes (1902 m) were drilled, mostly at Alpine; drilling these last two years averaged 229 m length.

Half of the drilling (19 holes) has been in the Tower zone, defining a near-surface horizon of altered and variably silicified lithic crystal tuff. This altered horizon has a mineralized zone ~40 m thick with an average of ~0.2 Au and 1.5 g/t Ag associated with fine pyrite (possibly marcasite) with irregular fine quartz veinlets and cryptocrystalline quartz as cement to breccias, locally associated with strong As, Sb and Mo anomalies. Three shallow holes have been drilled at Line 6, with the best result being 0.9 g/t Au over 3.6 m. Five holes have been drilled at Mik, with the best results being 3 g/t Au over 1.5 m at a shallow level, plus up to 45 g/t Ag (and 0.1 g/t Au) in the one deep hole, associated with milky quartz. Eight holes drilled at Alpine identified altered lithic-crystal tuff with similar anomalous Au values found at nearby Tower. Most drill holes have been oriented ~ESE to ENE (or WSW; Fig. 1). To date the best results encountered have been 119 g/t Au and 273 g/t Ag in surface float and up to 66 g/t Au in chip sampling. The best drill interval is 50 m at 0.54 g/t and 4.77 g/t Ag. Further background information is available in assessment reports, including those by Stewart and Gale (2006), Chang and Gale (2009), Raffle and Proenza (2012), and Peters (2016, 2017).

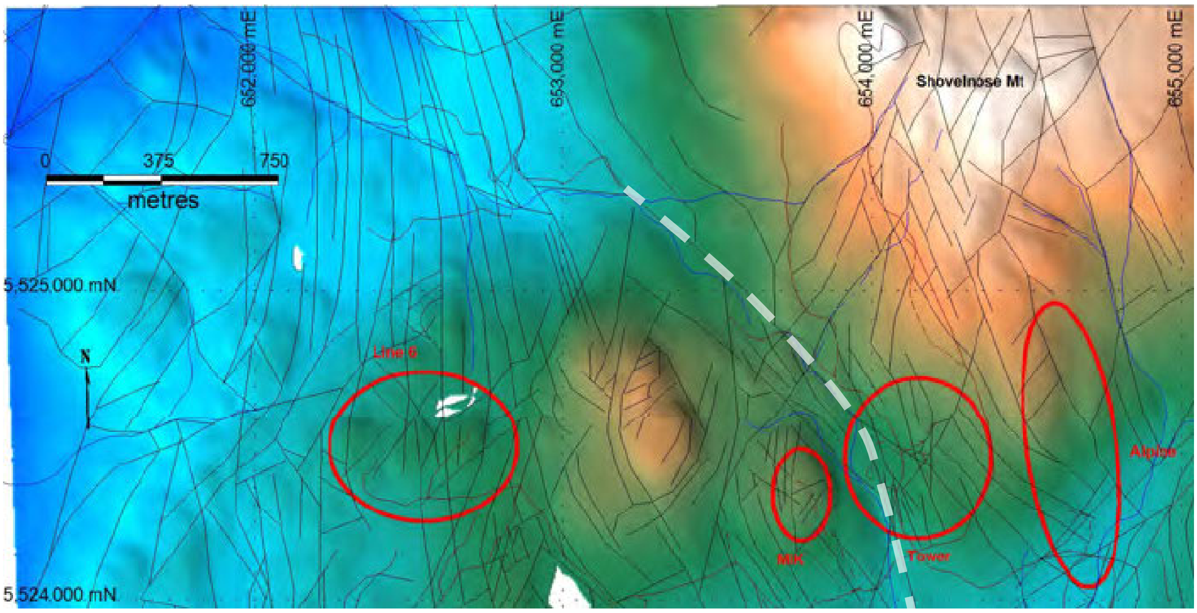

Fig. 1. LIDAR-based topography as well as structural interpretation (from Peters, 2017). Dashed white line shows the Tower Creek fault, oriented NNW between the Tower and Mik zones, followed by the drainage; eastern half of the prospect dominated by NNW and NNE fracture pattern.

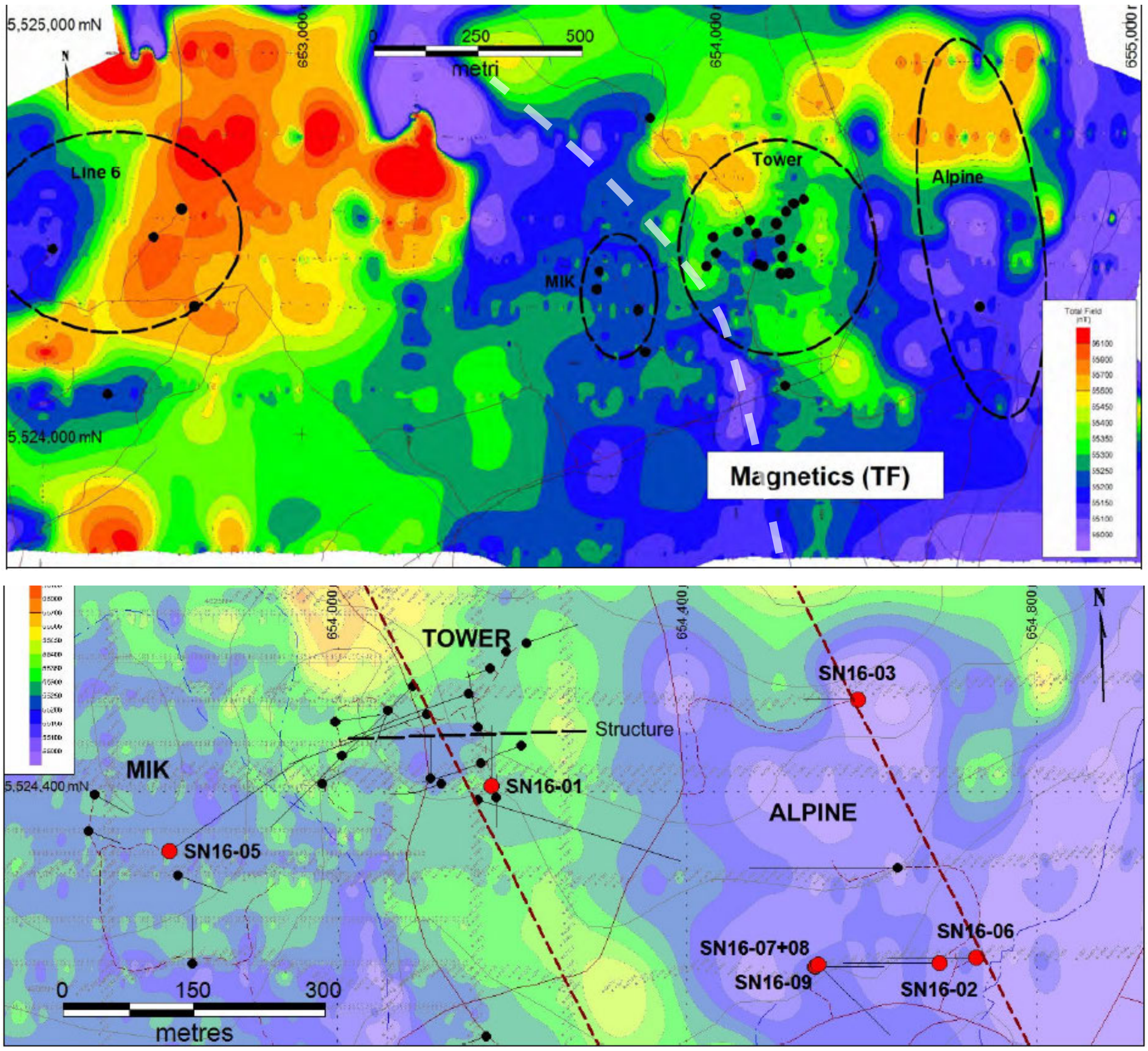

Fig. 2. a) Total force ground magnetic survey, with E-W lines spaced at 100 m (200 m on margins), and six N-S lines, three in the Tower zone. Trend of Tower fault (Fig. 1) shown with white dashed line. b) Detailed area of drilling from Mik to Alpine, plus 2016 labels, showing drill traces and survey lines (faint lines in background).

Observations

Outcrop in the prospect area is not extensive (Fig. 3), with areas of quartz veins limited; structures with quartz from 1-10 mm to ~20 cm wide are present. The quartz is dominantly cryptocrystalline (Fig. 3e), but locally there are bands with colloform textures (Fig. 3d); in the Tower zone the cryptocrystalline quartz is dark, due to the presence of finely crystalline, disseminated pyrite (Fig. 3b). The dark cryptocrystalline quartz is also present at depth in drill core, both at shallow depths and deeper (Fig. 4), with colloidal textures indicating that the quartz was deposited in open spaces as a gel (e.g., Fig. 4d, f, in the Ag-rich deeper portion cut by SN-15-05 and SN-16-05, drilled WSW and ENE from Tower and Mik, respectively).

Fig. 3. a, b) Tower zone, outcrop with N-S fractures cut by ~E-W veins filled by dark quartz (pointer); closeup of float with fractured zone cemented by dark cryptocrystalline quartz and fine pyrite. c, d) Vein outcrop at Mik, looking north, with colloform bands in massive cryptocrystalline quartz veins (up to 20 cm width), with assays reporting up to 38 g/t Au in chip samples. e, f) Brookmere (west of Line 6, Fig. 1), outcrop of quartz veins ~1 cm (pointer) up to ~20 cm wide, brecciated, with massive cryptocrystalline texture; no colloform bands present.

Fig. 4. Tower zone. a) SN-16-01-59 m, brecciated zone, cemented by cryptocrystalline quartz with fine dark pyrite; 0.7 g/t Au, 10 g/t Ag, 656 ppm As, 36 ppm Sb, 185 ppm Mo. b) SN-14-09-102.9 m (north to south), brecciated zone, multiple events, fine dark siliceous cement (local marcasite); 1.2 g/t Au, 16 g/t Ag, 1045 ppm As, 51 ppm Sb, 580 ppm Mo. c) SN-15-05-242 m, early clasts with margin of cream-colored adularia rhombs, brecciated and cemented by cryptocrystalline quart and pyrite; 0.3 g/t Au, 31 g/t Ag, 240 ppm As, 11 ppm Sb, 1340 ppm Mo. d) 242.5 m, dark silica gel infill, graded. e) 245 m, brecciated pyrite and marcasite, cemented by light and dark silica gel; 0.6 g/t Au, 27 g/t Ag, 388 ppm As, 9 ppm Sb, 1440 ppm Mo. f) Mik zone, SN-16-05-374, 375 m, deep hole drilled to ENE below SN-16-01 (above). Silica gel infill (pointer) of open space after brecciation, fine pyrite; left clast, 0.04 g/t Au, 18.5 g/t Ag, 5 ppm As, 1 ppm Sb.

The drilling from 2011-2014 (26 holes, average 119 m, mostly at an angle of 45 to 70°) penetrated to less than 100 m depth. Much of the drilling during 2015-2016 (14 holes, average 229 m) was also shallow, but the average was higher due to three holes of 401 to 455 m length. Half of the drilling (Fig. 5) has been in the Tower zone (Fig. 6a), but in 2016 all but two holes were drilled in the Alpine zone, returning the best drill results to date (3.6 g/t Au over 2 m to 16.7 g/t Au over 0.5 m), albeit in narrow intersections of 0.2 to 2 m length (Fig. 6b).

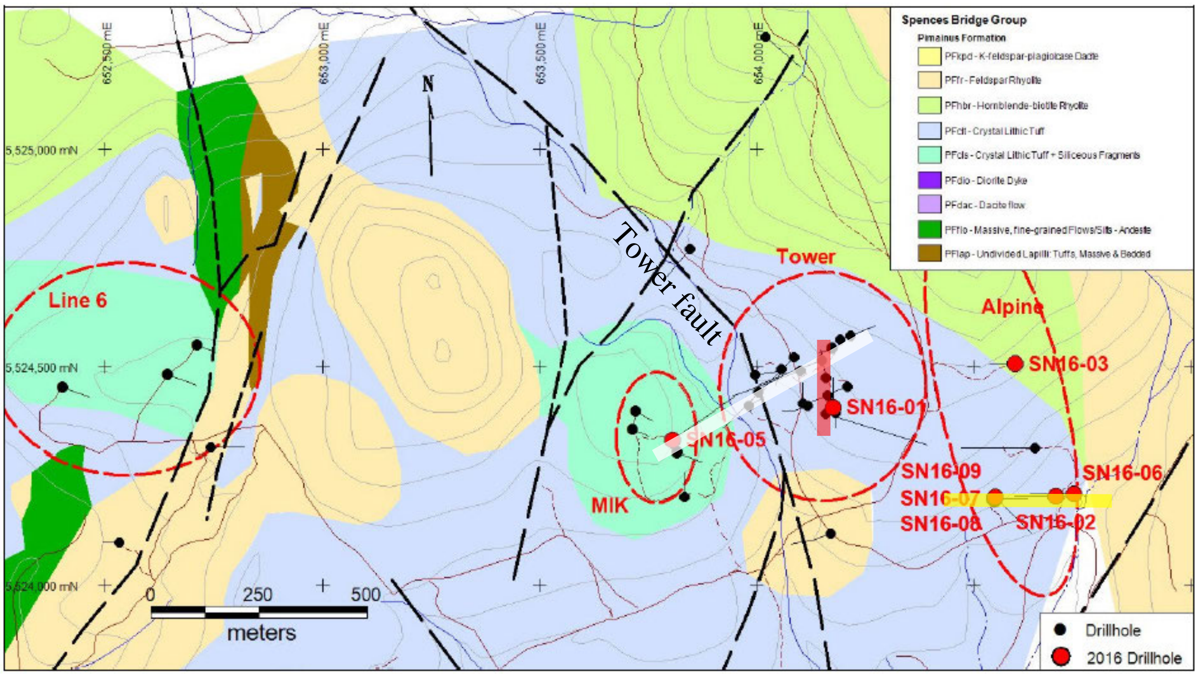

Fig. 5. Geologic map of the principal anomalous areas of alteration and quartz veinlets on the Shovelnose property; the Brookmere zone is west of Line 6 (from Peters, 2017). The collars and traces of drill holes are shown. Line of cross section in Fig. 6a shown in white, Fig. 6b in yellow, and Fig. 6c in red.

The shallow (to ~50 to 70 m depth) lithology (Fig. 6) is dominated by a polymictic fragmental unit (Fig. 7) that is strongly altered to clay, with a variable degree of silicification. Lithic clasts consist of clay or silicic altered rock, veined fragments, as well as felsic material. The dominance of lithic clasts that were altered prior to incorporation in the fragmental unit indicates a local source, and although this unit has been referred to as a crystal lithic rhyolite tuff of the Princeton Group, it may have a phreatomagmatic origin (as also suggested by Chang and Gale, 2009; their reference to clasts of silica "sinter" is most likely due to finely laminated fiamme). This shallow horizon reported up to 0.5 g/t Au and 4.6 g/t Ag over 53 m from 21 m depth in SN-12-04 in the Tower zone (Fig. 6a), but the typical intervals at Tower and Alpine report 0.2-0.25 g/t Au and ~1 g/t Ag over 40 to 70 m (Fig. 6). This horizon, as logged, thins markedly from Tower to the west at Mik (Fig. 6a), whereas it is thicker at Alpine (Fig. 6b); a north-south section at Tower (Fig. 6c) indicates that this horizon is offset downward to the south, although the underlying rhyolitic tuff appears horizontal.

At depth in the Alpine zone there are well-developed and Au-mineralized – albeit narrow, 1 m – intervals of 3.6 g/t Au associated with As-rich (arsenian?) marcasite and pyrite with high Mo (Fig. 8a) as well as finely colloform-banded veins. The breccia and veins cut a polymictic unit with flattened clasts and evidence for gels having deposited in open space (Fig. 8b). In addition to being As and Mo rich, this interval also contains up to 25 ppm Se, likely forming Ag-selenide minerals with up to 36 g/t Ag; 15 m above this level there is another vein with well-formed colloform bands (Fig. 8c).

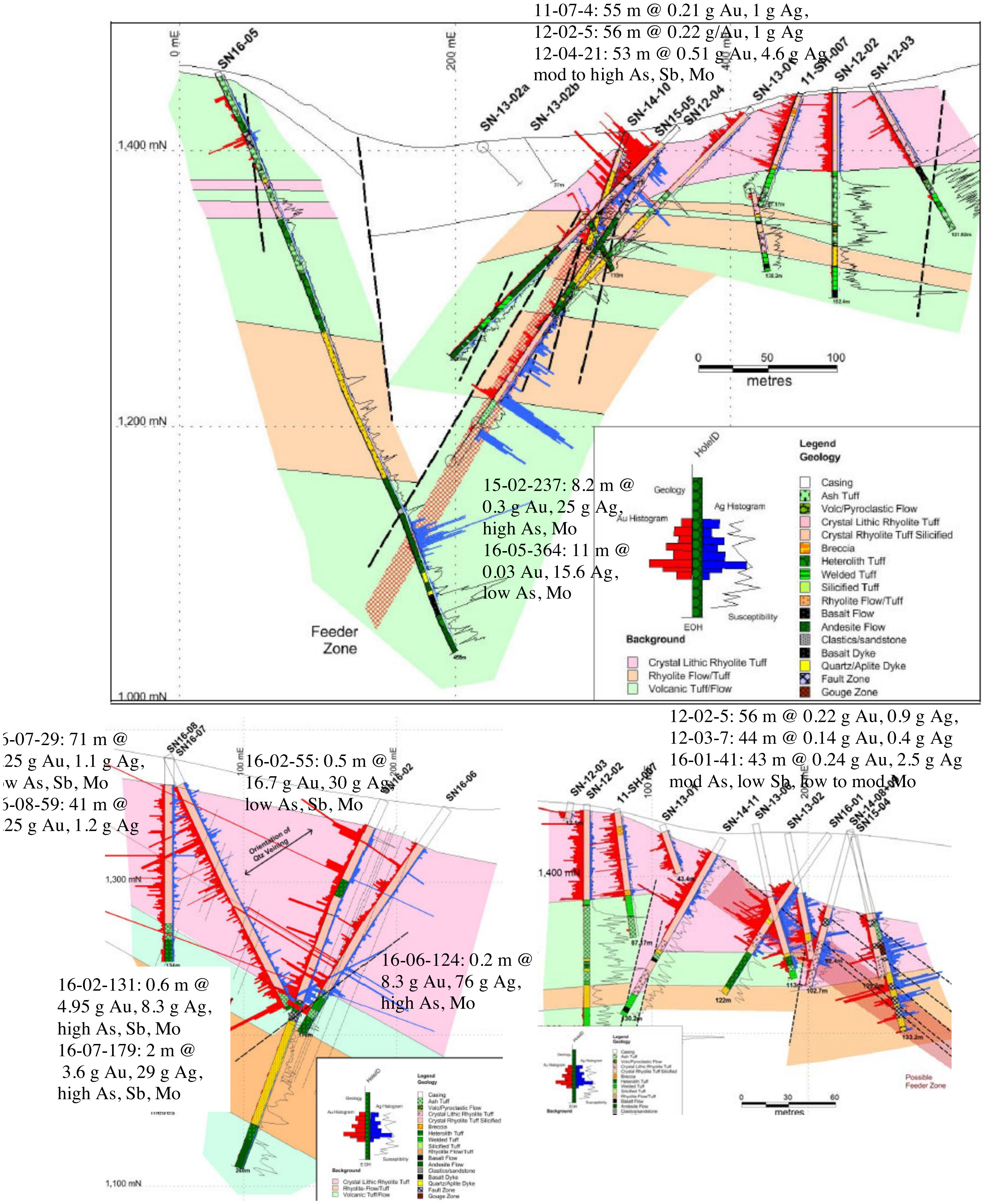

Fig. 6. a) Cross section, Mik to Tower zone (WSW-ENE; white trace, Fig. 5). Shallow zone in altered lithic tuff with ~0.2 g/t Au; ~200 m depth zone of Ag (15-25 g/t) with low Au, variable As, Mo. b) Cross section, Alpine (W-E; yellow trace, Fig. 5); correlation indicates a dip of the polymictic horizon to the east. Highest Au intervals in drill holes to date, over 0.2 to 2 m, are listed (SN-16-02-55 m, Fig. 7c); shallow intersection has low As, Sb, Mo, whereas those at depth show high As, Sb, Mo. c) Correlation along the N-S cross section at Tower (red trace, Fig. 5) suggests offset down of the polymictic fragmental unit to the south, although the underlying rhyolitic tuff appears to have a flat upper surface. At Alpine, the northern-most drill hole, SN-16-03, does not report this unit, and it appears to dip to the south between SN-15-01 and SN-16-02 (Peters, 2017, his Fig. 10).

There is evidence at both Alpine (Fig. 9) and Mik (Fig. 10) for dike intrusion at Shovelnose. At Alpine the dike has a flow-banded margin (Fig. 9a) where it intruded into a polymictic fragmental unit that contains altered fragments; in turn the dike is cut by quartz veinlets. This indicates a syn-hydrothermal timing of intrusion, but likely early in the history of the hydrothermal system, since vein clasts are not common in the polymictic fragmental unit (Fig. 9b). At Mik there is also evidence for syn-hydrothermal phreatomagmatic activity since clasts of definite juvenile (magmatic) origin are present with altered clasts in the polymictic unit (Fig. 10b, c), with this unit subsequently intruded by a felsic dike (Fig. 10a). These polymictic fragmental units, both shallow deposits with some lateral continuity (Figs. 6a, 7a, b) as well as the deeper, probable cross-cutting bodies (Figs. 9, 10), indicate intrusion during hydrothermal activity, a common feature in other epithermal deposits world-wide. In some cases where there are vein clasts incorporated in the polymictic fragmental units (Fig. 11), it appears that the veins were formed after emplacement of the polymictic fragmental units and formed as the result of hydrothermal brecciation.

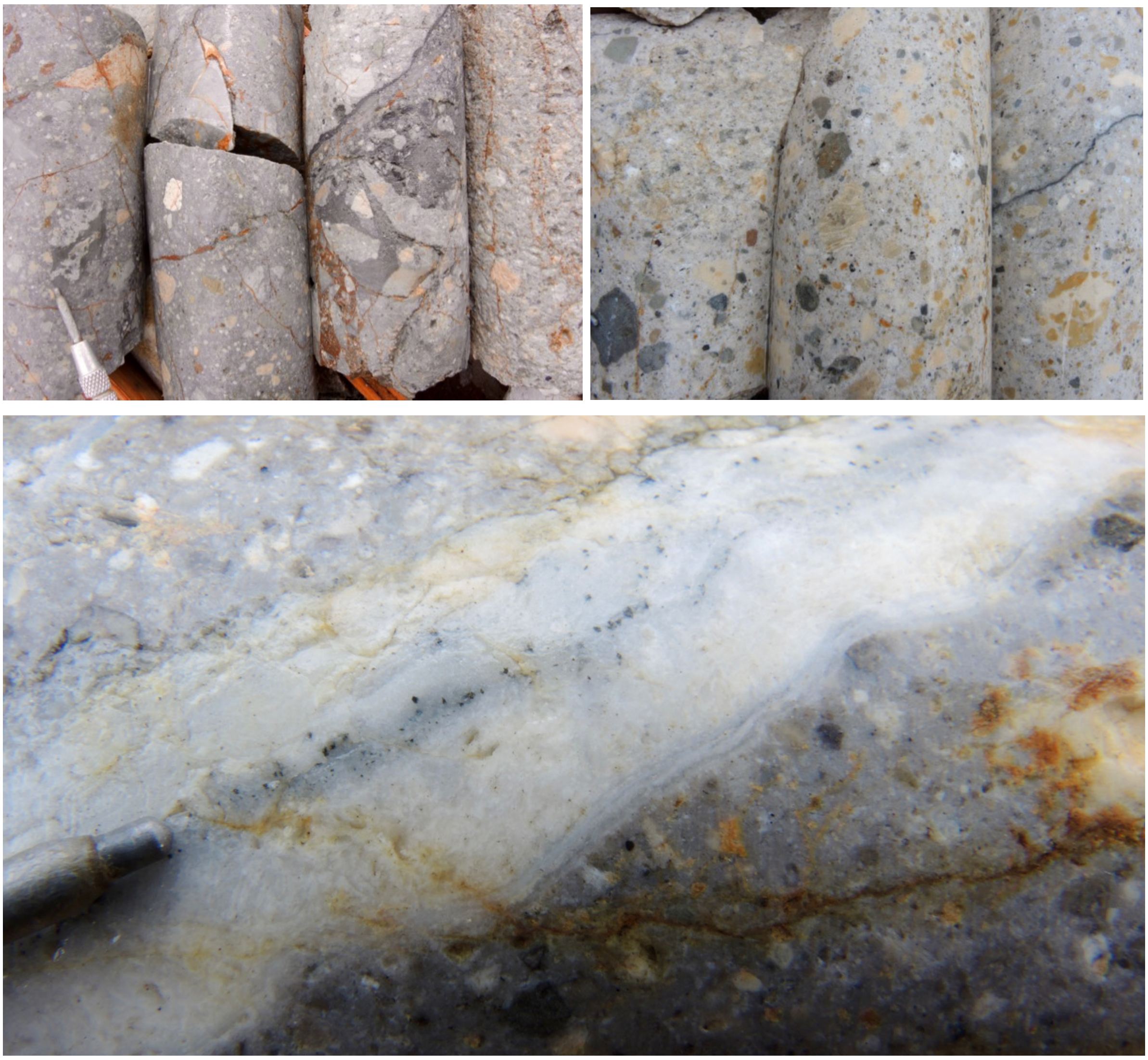

Fig. 7. a) Tower, SN-16-01 (drilled south to north), 70.5, 71.5, and 75.9 m, polymictic fragmental unit (veined clast, pointer, 70.5 m), locally brecciated and cemented by black cryptocrystalline quartz (75.9 m); 80.2 m, lithic tuff with altered clasts. Au, 0.2, 0.6, 0.9, 0.07 g/t; Ag, 1.8, 3.1, 3.1, 1.0 g/t; As, 193, 135, 340, 53 ppm. Gold highest in the brecciated unit, lowest in the tuff. Alpine, SN-16-02 (Fig. 6b). b) 89.3 m, polymictic fragmental unit with altered clasts, flow-banded rhyolite and other felsic clasts; 0.1 g/t Au, 0.5 g/t Ag. c) 55.2 m, polymict fragmental unit cut by quartz vein with colloform bands on margin and centerline of black sulfides; 0.5 m at 16.7 g/t Au, 29.9 g/t Ag, 113 ppm As, 4 ppm Sb, 20 ppm Mo, 4.4 ppm Se.

Fig. 8. Alpine, SN-16-07 (cross section, Fig. 6b). a) 178 and 179 m, marcasite-cemented breccia (top) and brecciated interval with well-developed colloform bands; Au, 3.6/3.6 g/t; Ag, 36/13 g/t; As, 6660/330 ppm; 583/25 ppm; 675/498 ppm Mo, 25/15 ppm Se. b) 179 m, close-up, showing elongate (flattened) clasts (upper left) with bands of dark colloform silica gel – draped over clast, quartz and pyrite in a fragmental texture (3.6 g/t Au over 1 m). c) 163.8 m, colloform-banded quartz veined with scalloped margin cutting polymictic fragmental unit, with contact of dark sulfide; 0.33 g/t Au, 4.3 g/t Ag, 76 ppm As, 3 ppm Sb, 127 ppm Mo, 2.1 ppm Se.

Fig. 9. Alpine. a) SN-16-03, 150-153 m; contact clay-altered polymictic fragmental unit, with felsic and altered lithic clasts (<5 ppb Au), intruded by flow-banded dike with veinlets (pointer; up to 0.1-0.2 g/t Au). SN-16-02 b) 132.5 m, polymictic fragmental unit with altered clasts plus flow-banded rhyolite; 0.26 g/t Au, 6.3 g/t Ag. c) 131.5 m, brecciated intervals with massive cryptocrystalline quartz as well as colloform bands of marcasite and quartz; 4.95 g/t Au, 43.7 g/t Ag, 25.6 ppm Se, 1470 ppm As, 109 ppm Sb, 408 ppm Mo.

Fig. 10. Mik zone, SN-16-05. a) 387-401 m, polymictic fragmental unit with juvenile clasts, intruded by felsic dike at 393-399 m. b) 388.4-389.4 m, reddish juvenile clasts (<5 ppb Au, ≤0.8 g/t Ag) in polymictic fragmental unit, including minor altered clasts. c) Close-up of juvenile clasts, wispy margins, mixed with matrix.

Fig. 11. Mik zone, SN-16-05-389.7 m, polymictic fragmental unit with reddish juvenile clasts, elongate (upper left), subsequently brecciated and cemented by quartz and siliceous gel (above pointer), i.e., syn-hydrothermal phreatomagmatic intrusion; <5 ppb Au.

Discussion

The abundance of phreatomagmatic activity at Shovelnose produced cross-cutting units (Fig. 10) as well as surficial deposits (Fig. 7a, b) of polymictic fragmental material. The presence of altered clasts in units that were subsequently cut by veins confirms a syn-hydrothermal timing, whereas the lack of vein clasts suggests a relatively early-hydrothermal timing, prior to the formation of veins. The phreatomagmatic activity was likely triggered by dike intrusion into the hydrothermal system, and there is evidence for (later) dikes as well, some with a syn-hydrothermal timing, as these cut the polymictic fragmental units but are also cut by veins. Such dikes likely intruded along major structures that were likely feeders to the hydrothermal system, and therefore it is essential to distinguish different dike events and correlate them between drill holes, along with the cross-cutting polymictic fragmental bodies. This will allow correlation with vein orientation at surface (and in oriented core), which will contribute to the azimuth and dip of drill holes designed to target deep (below 100 m) veins.

There are sharp distinctions in the characteristics of volcanic, volcanic-sedimentary and volcanic-hydrothermal deposits (Fig. 12) at Shovelnose, and these characteristics should allow these different horizons – including those with sharp facies variations as well as some associated with local depocenters – to be identified. Stewart and Gale (2006), Daikow and Barios (2008) and Raffle and Proenza (2012) group the felsic tuffs, including those with altered lithics, into the Cretaceous Shovelnose Group, with only the local basalts belonging to the Eocene Princeton Group. By contrast, Chang and Gale (2009) suggest that the crystal lithic tuffs that host much of the veining are part of the Princeton Group. Regardless of this distinction – which has relevance for exploration elsewhere in the region – the polymictic fragmental unit at Shovelnose with abundant altered lithic clasts likely has a local origin.

The rhyolite flows NE of the area of drilling, toward Tower Hill (PFfr, PS4; Pimainus Formation of the Spences Bridge Group) have ubiquitous flow banding of various orientations (Raffle and Proenza, 2012) that may indicate the near-surface expression of a flow dome. Tuffaceous units on flanks of flow domes present sharp lateral facies changes, and the domes themselves are competent bodies in which fractures stay open and can result in dome-hosted epithermal veins (e.g., El Peñon, Chile).

There is evidence, both at surface and in some drill holes – particularly those recently drilled at Alpine – for the hydrothermal system to be prospective for gold mineralization. In addition to 1.1 to 3.5 g/t Au in several 1 to 2 m intervals in drill core, and a few 5 to 16 g/t Au over 0.2 to 2 m intervals, there are broad zones of 0.1 to 0.5 g/t Au over 20 to 60+ m intervals at the Tower and Alpine zones at shallow depths. SN-16-06 to 09, recently drilled in the southern portion of the Alpine zone, returned the most consistent results of narrow higher grade intervals within broad (96 to 181 m) anomalous zones of 0.11 to 0.23 g/t Au.

The metal signature is variable (Fig. 6a-c). In most mineralized intervals, the Ag:Au ratio is ≤10:1, typical of relatively sulfide-poor epithermal systems like Shovelnose. The associated elements include As, Sb, Mo, ±Se, but not in any clearly recognized pattern. Shallow low-grade zones as well as deep high-grade intervals can be highly anomalous in As (100s to ~1500 ppm), Sb (10s to ~100 ppm) and Mo (100s to 1000s ppm). These elements commonly accompany epithermal Au-Ag mineralization, including Mo, which occurs in some deposits with marcasite (e.g., Mule Canyon and Sleeper, Nevada). Selenium is locally anomalous, to ~25+ ppm, in some gold-rich intervals – likely present as a Ag selenide, again typical of epithermal deposits that share some features of Shovelnose, including relatively low sulfide content (e.g., Hishikari, Japan). There are also narrow Au-rich veins that are not anomalous in As, Sb and Mo. Also, in the deep interval between Mik and Tower, SN-15-05 and SN-16-05 there is a Ag-rich zone with a Ag:Au ratio of >75:1 (Peters, 2017, his Fig. 14), with a variable, high to low concentration of As, Sb and Mo. These latter elements appear to be related to the presence of marcasite, a low-temperature form of FeS_2 that is present elsewhere as fine cubes of pyrite. This distinctly different Ag:Au ratio in the deposit suggests that there may have been two separate precious-metal pulses of mineralization into the system. The highly variable As, Sb, Mo is likely related to the stability of marcasite, a mineral that is common on the lower temperature margins (shallow and lateral) of mineralized veins.

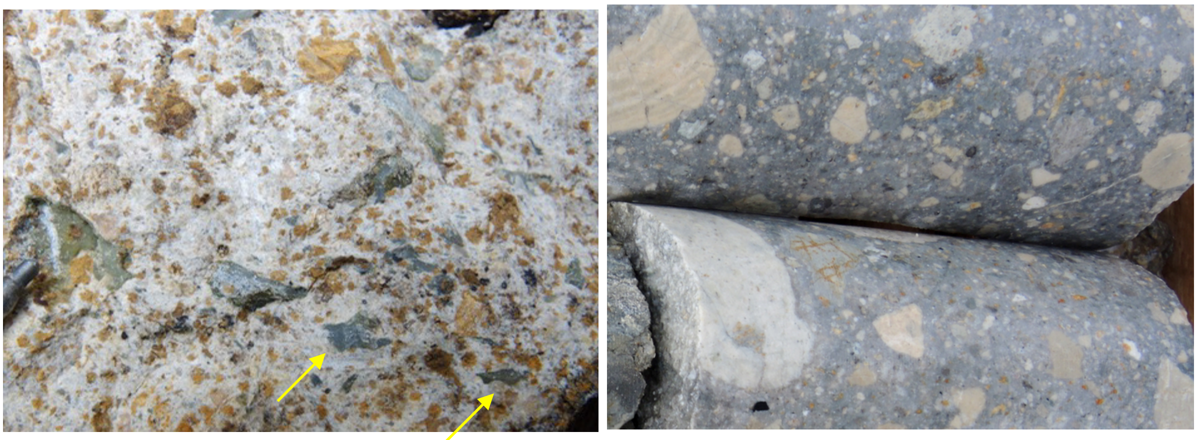

Fig. 12. Comparison of a) pumice lithic crystal tuff (Mik outcrop) of volcanic origin, and b) Alpine (SN-16-02-131.5 m), polymictic fragmental unit. Mik sample has monomictic lithics plus greenish clay-altered pumices (pointer), some with local flattenning due to partial welding (arrows), in a crystal matrix. Alpine sample from drill core shows a polymictic (polylithic) fragmental texture with flow-banded rhyolite to altered lithic clasts, either with a local depositional distribution or due to a cross-cutting phreatomagmatic intrusion.

Conclusions

- The Shovelnose property features an epithermal vein system hosted by volcanic and volcanic-hydrothermal units with syn-hydrothermal dike intrusions. Reported alteration is dominated by clays that formed at low temperature, and most veins, veinlets and breccia cement consist of cryptocrystalline to silica gel material that also indicates a low temperature of formation. This is likely due to a shallow paleodepth, i.e., a shallow level of erosion, and/or a location on the margin of the paleohydrothermal system.
- The shallow polymictic fragmental unit (logged as a crystal lithic tuff), largely encountered at Tower and Alpine, is likely of phreatomagmatic origin given the abundance of altered clasts, i.e., a surficial deposit that is proximal to its source vent; this is supported by its thinning in the direction of Mik. Although the common ~0.1-0.5 g/t Au over ~40-70 m drill intervals may be related to fine quartz veinlets developed in this horizon, another possibility is that this geochemical signature is due to low levels of mineralization in the altered clasts that are contained in this unit (this possibility could be tested by selectively sampling all veinlets in a few 1-m intervals, by saw cut, and then assaying both the selected veinlets as well as the rest of the intervals).
- There are also polymictic fragmental units recognized at greater depth (both Alpine and Mik) as well as syn-hydrothermal dikes, both of which will have intruded along zones of structural weakness. It is essential to determine structural controls on permeability, as indicated by cross-cutting features (dikes, phreatomagmatic bodies, veins), in order to target deeper structural zones that may be associated with mineralized veins. In addition, indications of paleothermal conditions, particularly vectors (with increasing depth and/or lateral) can be determined from alteration mineralogy to help in target selection.
- The epithermal characteristics, size, and local indications of mineralization at the Shovelnose property indicate that untested potential remains, particularly in that most of the 39 drill holes tested shallow intervals less than 100 to 150 m depth. Only half a dozen holes were drilled to ~200 to 300 m depth over ~1 km strike length in the Mik-Tower-Alpine area, with azimuth within ±30° of east-west. At present the major structural direction(s) are not fully known; demagnetized linear features may be related to major structures. There is alteration and vein evidence for the prospect to be continuous at least ~1.5 km west of the Mik-Tower-Alpine area. Given the extent of till cover in the area, it is also possible that the focus of the system is lateral from the principal area that has been drilled. An assessment of alteration mineralogy may help to identify the direction to the higher paleotemperature zone(s), deeper and/or lateral from the present area of drill testing.

Recommendations

- Compile fracture measurements from the surface (azimuth and dip) for each area of the prospect, and determine the relationship between different areas (distinct fault blocks?). Relate the vein orientations at the surface to mapped structures.
- Use the improvement in knowledge of the lithology gained from the holes drilled during 2011 to 2016 and refine the stratigraphic column prior to relogging the core. Establish a consistent descriptive terminology and record details in logs that include the lithology(ies) of lithic clasts in fragmental units (volcanic fragmental and brecciated intervals), etc.
- Correlate stratigraphic horizons, dike intersections, etc., between drill holes on sections, in order to identify fault offset and major structures. In particular, distinguish the polymictic fragmental units (mainly of phreatomagmatic origin), that crosscut lithology in places at depth, from the lithic tuffs of volcanic origin (typically monomictic, or at least without an altered clast content). Correlation of syn-hydrothermal dikes as well as phreatomagmatic intrusions will help to identify major structures that may have been subsequently reopened at depth and mineralized with epithermal quartz veins.
- Request an experienced geophysicist who is briefed on the geology of the prospect to examine the ground magnetic surveys to determine the data quality, and if adequate, process to RTP (reduced to pole) as well as vertical gradient, as appropriate to identify linear features of demagnetization as well as intrusive bodies.
- If the magnetic information indicates linear features associated with alteration, consider increasing the resolution of the survey to 50-m line spacing. Use the magnetic susceptibility data from representative drill core, as appropriate, in the subsequent processing. Examine depth slices of magnetic signatures and assess the potential to identify corridors of demagnetization associated with fracture/fault zones.
- Conduct an orientation survey of alteration mineralogy (particularly clays) by SWIR (short wave infrared). Collect samples in different lithologies from representative drill holes in each area, perhaps ~100-150 samples. Based on the results, consider whether a more extensive sampling program (e.g., rental of SWIR equipment with in-house interpretation of spectra) is warranted on more holes and in more detail, as well as measurement during logging of new holes while drilling.
- Oriented core should be required during future exploration drilling to allow the orientation of sub-surface veins and other structures to be determined, to incorporate into a structural model of the deposit that can be tested with further drilling.
- Consider the larger area, and whether there is evidence for hydrothermal activity beyond the area of known gold-in-soil anomalies and indications of mineralization in outcrop and drill hole, e.g., toward the possible flow-dome of Tower Hill.

Qualifications

I, Jeffrey W. Hedenquist, of Ottawa, Canada, hearby certify that:

- I am President of Hedenquist Consulting, Inc., incorporated within the province of Ontario. I am an independent consulting geologist with an office at 160 George Street, Suite 2501, Ottawa, Ontario, K1N9M2, Canada; telephone 1-613-230-9191.
- I am a graduate of Macalester College, St. Paul, Minnesota, USA (B.A, Geology, 1975), The Johns Hopkins University, Baltimore, Maryland, USA (M.A., Geology, 1978), and the University of Auckland, Auckland, New Zealand (Ph.D, Geology, 1983); in addition, I have received degrees of Doctor *honoris causa* from the universities of Turku (2004) and Geneva (2014).
- International recognitions include the Kato Takeo Gold Award (2011), Society of Resource Geology of Japan; the Duncan Derry Medal (2005), Geological Association of Canada; the William Smith Medal (2004), The Geological Society (London); and the Society of Economic Geologists' Silver Medal (2000) and Ralph W. Marsden Award (2013).
- I have practiced my profession as a geologist continuously since 1975, working as a researcher for the U.S. Geological Survey, the New Zealand Department of Scientific and Industrial Research – Chemistry Division, and the Geological Survey of Japan until the end of 1998. I have published widely in international refereed journals on subjects related to epithermal and porphyry ore-deposit formation and active hydrothermal systems. I consulted to the mineral industry and various governments as a New Zealand government scientist from 1985 to 1989, and I have been an independent consultant since January, 1999.
- I am a Fellow of the Society of Economic Geologists and have served in executive officer positions, including President, 2010; I am also a member of the Society of Resource Geology of Japan and the Geochemical Society. I was Chief Editor of the 100th Anniversary Publications of *Economic Geology* and am Associate Editor of the journal, as well as an editorial board member of *Resource Geology*; I have previously served as editorial board member of *Geology, Geothermics, Journal of Exploration Geochemistry, Geochemical Journal* and *Mineralium Deposita*.
- This report is based on information and reports provided to me by Westhaven Ventures, Inc., other previous reports, and personal observations in the field.
- I have no direct or indirect interest in Westhaven Ventures or related companies, in the property described in this report, or in any other properties in the region.
- I hearby grant permission for the use of this report in its *full and unedited form* in a Statement of Material Facts or for similar purpose. *Written permission* must be obtained from me before publication or distribution of *any excerpt or summary*.

Hedenquist Consulting, Inc.

Jeffrey W. Hedenquist

Jeffrey W. Hedenquist, Ph.D.
President

Date: May, 2017
Ottawa, Canada